C-1 LAND GRADING AND SLOPE PROTECTION

PURPOSE & APPLICATIONS

Land grading and slope protection is the shaping of the existing land surface in accordance with a plan as determined by engineering survey and layout. Its purpose is to provide for erosion control and vegetative establishment on those areas where the existing land surface is to be reshaped by grading. Land grading is generally not recommended in areas with an existing intact forest floor and/or native vegetation.

CONSIDERATIONS

- Land grading is a major source of sedimentation and must be carefully planned and carried out.
- The use of phasing, natural buffers, mulching, and temporary and permanent seeding should be the primary methods of addressing erosion control for land grading projects.
- Fall and winter erosion control measures must be upgraded and refined to protect the site from spring runoff and snowmelt.

Plan the project to fit the site.

Inventory the site and evaluate its strengths and weaknesses. Tailor the lay-out of buildings, roads and utilities to the topography of the site. Follow these general guidelines:

- Restrict construction activities to the least critical areas on the site.
- Protect and maximize existing native vegetation and natural forest floor, thereby reducing impervious areas on the site.
- Disperse stormwater to areas or undisturbed forest floor wherever possible, rather than concentrate it into channels.
- Align roadways following natural contours rather than up and down steep slopes.
- Cluster buildings to minimize the amount of earth movement needed.
- Divert clean water away from the immediate construction area to reduce the threat of erosion.

Minimize the area of exposed soil exposed at one time.

- Sequence construction of a project. Don't open up the whole site at one time. Build in phases.
- Preserve natural vegetation by flagging it and protecting it in the field.
- Create buffer strips of undisturbed vegetation between construction areas and environmentally vulnerable areas such as watercourses, ponds and wetlands.
- Lay down temporary mulching on any exposed soil until final grade is reached.
- Immediately re-seed areas ready for revegetation.
- If construction extends into the fall and winter months, upgrade all erosion control measures to protect the site from spring runoff.

SPECIFICATIONS

Grading Plan Design Specifications

The plan must show existing and proposed contours of the area(s) to be graded. The plan shall also include practices for erosion control, slope stabilization, safe disposal of runoff water and drainage, such as waterways, lined ditches, reverse slope benches (include grade and cross section), grade stabilization structures, retaining walls, and surface and subsurface drains. The plan shall also include phasing of these practices. See the detail drawings located at the back of this section for proper land grading. The following shall be incorporated into the plan:

- Provisions shall be made to safely conduct surface runoff to storm drains, protected outlets or to stable water courses to ensure that surface runoff will not damage slopes or other graded areas (See VEGETATED WATERWAY BMP and WATER DIVERSION BMP).
- Cut and fill slopes that are to be stabilized with grass shall not be steeper than 2:1. Where the slope is to be mowed, the slope should be no steeper than 3:1 (4:1 is preferred because of

safety factors related to mowing steep slopes). Slopes exceeding 2:1 shall require special design and stabilization considerations that shall be adequately shown on the plans.

- Reverse slope benches or diversions shall be provided whenever the vertical interval (height) of any 2:1 slope exceeds 20 feet; for 3:1 slope it shall be increased to 30 feet and for 4:1 to 40 feet. Benches shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops, etc. shall also be taken into consideration when designing benches.
- Benches shall be a minimum of 5 to 6 feet wide to provide for ease of maintenance.
    - Benches shall be designed with a reverse slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. The bench gradient to the outlet shall be between 2 percent and 3 percent, unless accompanied by appropriate design and computations.
    - The flow length within a bench shall not exceed 800 feet (See WATER DIVERSION BMP).
- Surface water shall be diverted from the face of all cut and/or fill slopes by the use of diversions, ditches and swales or conveyed downslope by the use of a designed structure, except where:
    - The face of the slope is or shall be stabilized and the face of all graded slopes shall be protected from surface runoff until they are stabilized.
    - The face of the slope shall not be subject to any concentrated flows of surface water such as from natural drainage ways, graded swales, downspouts, etc.
    - Vegetation, gravel, riprap or other stabilization method must protect the face of the slope.
- South facing slopes of cuts and fills in silty and clayey soils are especially prone to shallow sloughing during the spring day/night freeze/thaw cycles. This shallow or deep sloughing may also be due to seepage not removed by subsurface drainage.
- On slopes with shallow sloughing, the soil should be removed to the depth of the slough or one and one half foot, whichever is greater, and filled with 6 inches of bank run gravel covered with one foot of field stone with an average size of at least 3 inches. Properly sized geotextile may be substituted for the gravel if desired. This stone should extend down the slope to a source of drainage, either a berm or a subsurface tile system.
- Cut slopes occurring in ripable rock may be serrated. See the detail drawings located at the back of this section for proper slope stepping. These serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. The nominal slope line shall be 1.5:1. These steps will weather and act to hold moisture, lime, fertilizer and seed thus producing a much quicker and longer lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.
- Subsurface drainage shall be provided where necessary to intercept seepage that would otherwise adversely affect slope stability or create excessively wet site conditions.
- Slopes shall not be created so close to property lines as to endanger adjoining properties without adequate protection against sedimentation, erosion, slippage, settlement, subsidence or other related damages.
- Stockpiles, borrow areas and spoil shall be shown on the plans and shall be subject to the provisions of this BMP.
- All disturbed areas shall be stabilized structurally or with vegetation in compliance with the appropriate BMPs.

Construction Specifications

- All graded or disturbed areas including slopes shall be protected during clearing and construction in accordance with the approved erosion and sediment control plan until they are adequately stabilized.

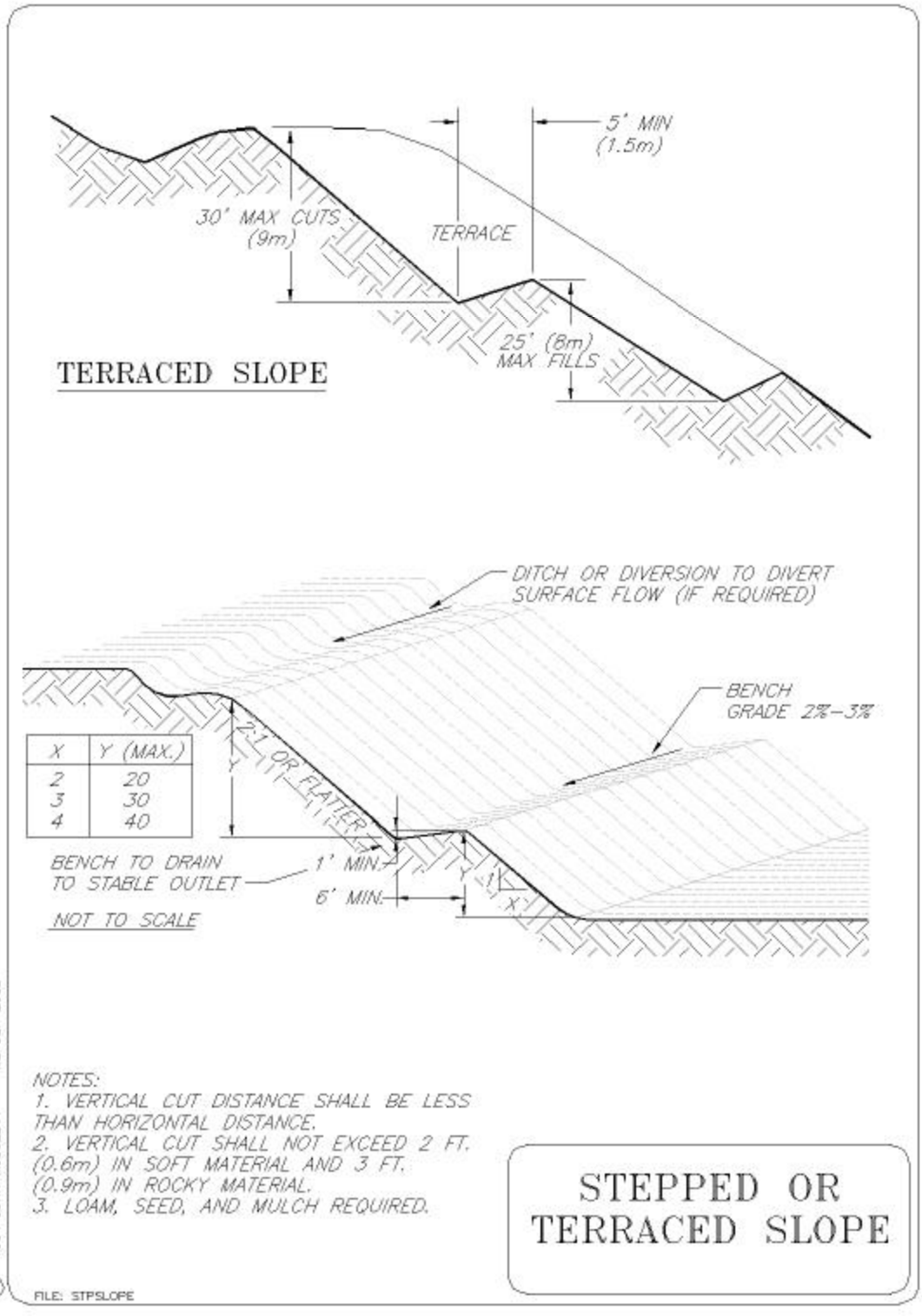
- All erosion, and sediment control practices and measures shall be constructed, applied and maintained in accordance with the approved erosion and sediment control plan.
- Areas to be filled shall be cleared, grubbed and stripped of topsoil to remove trees, vegetation, roots or other objectionable materials.
- Areas shall be scarified to a minimum depth of 3 inches prior to placement of topsoil.
- All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence or other related problems. Fill intended to support buildings, structures and conduits, etc., shall be compacted in accordance with local requirements or codes.
- All fills shall be placed and compacted in layers not to exceed 8 inches in thickness.
- Except for approved landfills or non-structural fills, fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris and other objectionable materials that would interfere with or prevent construction of satisfactory lifts.
- Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills.
- Fill shall not be placed on a frozen foundation.
- All benches shall be kept free of sediment during all phases of development.
- Seeps or springs encountered during construction shall be handled appropriately.
- All graded areas shall be permanently stabilized immediately following finished grading.

Timing and Phasing

Grading shall be planned so as to minimize the length of time between initial soil exposure and final grading. On large projects this should be accomplished by phasing the operation and completing the first phase up to final grading and seeding before starting the second phase, and so on.

MAINTENANCE

Any sign of rill or gully erosion shall be immediately investigated and repaired as needed.


5' MIN
(1.5m)
30' MAX CUTS
(9m)
TERRACE
25' (8m)
MAX FILLS
TERRACED SLOPE
DITCH OR DIVERSION TO DIVERT
SURFACE FLOW (IF REQUIRED)
BENCH
GRADE 2%-3%
X
Y (MAX.)
2
20
3
30
4
40
Y
2:1 OR FLATTER
BENCH TO DRAIN
TO STABLE OUTLET
1' MIN.
6' MIN.
Y
1
X
NOT TO SCALE
NOTES:
1. VERTICAL CUT DISTANCE SHALL BE LESS THAN HORIZONTAL DISTANCE.
2. VERTICAL CUT SHALL NOT EXCEED 2 FT. (0.6m) IN SOFT MATERIAL AND 3 FT. (0.9m) IN ROCKY MATERIAL.
3. LOAM, SEED, AND MULCH REQUIRED.
STEPPED OR
TERRACED SLOPE
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